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THE POTENTIAL INCREASE IN IRRIGATED ACREAGE IN MONTANA DUE TO INCREASED RED MEAT PRODUCTION

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THE POTENTIAL INCREASE IN IRRIGATED ACREAGE IN MONTANA DUE TO INCREASED RED MEAT PRODUCTION

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November 1976

Water Resources Division
Montana Department of Natural Resources
and Conservation

Helena, Montana

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SUMMARY

Montana's projected increase in red meat production, developed from historical cattle production growth trends and population projections developed by the Montana Department of Natural Resources and Conservation (DNRC) and other agencies, is from 1.82 to 2.43 times 1970 production by 2020. These figures are supported by the Series C red meat production projections for Montana developed by OBERS, which are similar to the upper limit (2.43 times 1970 production) of the projections presented in this report.

Montana's rangeland will not support the projected increase. There are 65,652,162 acres of grazing land in Montana, including range, pasture, and grazeable woodland; there are no additional acres that can be called into use as range. The 3,661,000 cattle, 70,500 horses, and 857,000 sheep in Montana in 1970 consumed almost all of the hay available in Montana in 1970 and fully grazed the state's pasture and range. If red meat production in Montana increases to meet the projected demand in 2020, the increased livestock feed requirement, in AUM, will be from 50,807,461 (for an increase factor of 1.82) to 66,198,160 (for an increase factor of 2.43), an increase above available feed in 2020 (without an increase in irrigated acreage) of from 8,944,807 AUM to 23,883,442 AUM. Since Montana's rangeland will support at most a very small increase in red meat production, another source of providing adequate livestock feed will have to be developed if the production increases projected in this report are implemented or even approached. That livestock feed supply could be provided by increased irrigation. If that method is chosen, from 1,057,285 to 3,187,281 acres of additional irrigation will be required in the state by 2020.

If no alternate source of providing livestock feed is developed, the increase in red meat production the state can support will be much smaller than those projected here.

INTRODUCTION

Livestock production constitutes the largest portion of Montana's leading industry, agriculture. Cattle production alone accounted for fifty percent of the cash receipts from marketing of Montana's agricultural commodities in 1970, and sheep and lamb production contributed another two percent (Montana Department of Agriculture 1972). It is primarily Montana's rangeland which supports the livestock industry, and the number of acres of rangeland in the state is limited. There are 54,107,043 acres of range and pasture and 11,545,119 acres of grazeable woodland, for a total of 65,652,162 acres currently supporting livestock in Montana. Many areas are already overgrazed, and there are no additional acres that can be called into use as range. In the future, there will be fewer acres available as range, not more, because of the projected growth of Montana's industrial community and population (see assumption 32). In addition, the accelerated expansion of grain exports and other agricultural factors have already caused the cultivation of some rangeland and will continue to do so, possibly claiming thousands of acres of range by 2020.

Other factors affect the future of Montana's range. One year's climate may affect rangeland productivity for several succeeding years. The timing and severity of the grazing stress placed on range plants can be even more far reaching in their effects. In relatively few years, overgrazing can cause damage to rangeland that may require decades to recover a good plant growth palatable to livestock.

Because Montana's range is currently utilized fully and in some cases overgrazed, the most likely potential source for significantly larger amounts of feed to support Montana's anticipated increase in beef production is an increase in the number of acres of irrigated hay and pasture. (Increased range production--see assumptions 21 and 30--due to improved management practices will provide some increase in available feed, but not enough to satisfy the demand indicated in table 13.)

Resource planning, such as that practiced by the Water Resources Division of the Montana Department of Natural Resources and Conservation (DNRC), requires projections of resource use. There are irrigation and red meat production projections given among the OBERS (Office of Business Economics and Economic Research Service) Series C projections (U.S. Water Resources Council 1972), but, by 1974, irrigation increases in the State exceeded the 45,200 acres projected by OBERS for 2020. It is evident that that increase would not support the large increase in beef production projected by OBERS. This report presents alternative irrigation and red meat production projections developed since early 1972 by the DNRC in concert with other State and Federal agencies, primarily the Soil Conservation Service (SCS), the Economic Research Service (ERS), the Bureau of Reclamation (USBR), and Montana State University (MSU).

Discussions between the DNRC and the Montana Stockgrowers Association, range scientists, and other agricultural technicians, as well as investigations of irrigation expansion and beef production in neighboring states, indicated that the meeting of the projected increased beef production demand is a good basis for projecting irrigation expansion. That is the basis upon which these projections were made. Economic feasibility and the availability of water were not, for this study, considered as restraints to irrigation.

Since the inception of this project, and even before, significant changes have occurred in the world and U.S. food situation. U.S. annual per capita consumption of beef increased from 84 pounds in 1964 to 113 pounds in 1971, for example. World and U.S. populations continue to increase rapidly. Because changes such as these are not reflected in the 1970 data used as a base, and because no attempt has been made to adjust the data to 1976 conditions, low, medium, and high figures have been projected for 2020 beef production, feed requirements, and needed irrigation. The resultant range of projections is based on beef production increase factors of 1.82 (low), 1.97 (medium), and 2.43 (high) times 1970 production by 2020. These increase factors, based on historic trends (see table 14, footnotes a, b, and c), were established through consultation with involved agencies. The OBERS red meat production projection (U.S. Water Resources Council 1972) is similar to the high projection in this report.

It was decided that livestock feed requirements would be measured by animal unit months (AUM) --the amount of feed or forage required for one month by an animal unit, which is defined as one 1,000-pound cow or its equivalent. With that decided, the study methodology consisted of calculating 1970 feed requirements for cattle and sheep numbers derived from Volume XIV of Montana Agricultural Statistics (Montana Department of Agriculture 1972) and for horse numbers derived from 1969 Census of Agriculture (U.S. Department of Commerce 1974) adjusted to 1970. Total feed required in 1970 was then compared with total feed available in 1970 (table 6).

Feed required and feed available were then calculated for 2020, based on projected animal numbers, projected changes in yields (assumptions 19, 20, 21, and 22), potential loss of land (assumption 32), and projected increases in feed conversion efficiency (assumption 2). In tables 13 and 14, the projected feed shortage for 2020 was converted to required additional acreage under irrigation.

OBERS projected yields for 2020 for grain, sugar beets, and silage were used in these projections; hay, range, and irrigated pasture yields were developed cooperatively by participating agencies.

Sheep production projections for 2020 were based on projected 2020 per capita wool consumption, as presented in The Nation's Range Resources (U.S. Department of Agriculture 1972); the increased 2020 horse population was projected to maintain its 1970 proportion to the expected human population; it was projected that milk cows would decrease from 47,000 (Montana Department of Agriculture 1972), the figure of 39,000 given by Montana Department of Agriculture (1974) remaining constant throughout the period of projections. If all of the three immediately preceding assumptions are completely invalid, the effect on total projected feed required would be less than eight percent and would result in an associated change in new irrigated acreage projections.

ASSUMPTIONS

RATE OF INCREASE

1. All increases will take place at a fixed rate over the fifty-year period.

LIVESTOCK

2. Feed conversion efficiency of livestock will increase ten percent by 2020.

Beef Cattle

3. Calf survival in 2020 will be at the same rate as in 1970 and is determined by subtracting calf deaths from calf births.
4. Twenty-five percent of calves raised are fed two months after weaning prior to being sold or put into feed lots. The rest are assumed to be sold at weaning and exported.
5. Of one- and two-year-old heifers, half were assumed to be one year old and the rest two years old. This was true of both 1970 and 2020 calculations.
6. The number of steers on farms and ranches in 2020 will increase at the same rate as beef production.
7. Feed consumed by steers during the year is assumed to equal the amount that would be consumed if the number of steers on hand January 1 were fed nine months.
8. The ratio of bulls to cows in 1970 was 1:23. That ratio will remain constant through 2020.
9. In 1970, cows averaged 1,060 pounds--which means they required 1.06 AUM per month. In 2020, cows will average 1,200 pounds and require 1.2 AUM per month.
10. It is assumed that ten percent of the cows, primarily old animals, are culled every year. Of these, eighty percent are sold, and twenty percent die. Fifteen percent of each year's calf crop is retained as replacement heifers for the cull cows. These percentage will remain constant through 2020.
11. The number of cows sold in 2020 was determined by subtracting cattle deaths from half of the total number of one- and two-year-old heifers.
12. Ten percent of the beef produced in Montana will go through Montana feed lots in 2020.
13. Allocation to each basin (Missouri, Yellowstone, and Columbia) of the amount of increased irrigation was based on its current (1970) share of beef cattle production.

Milk Cows

14. Milk cows on farms and ranches in 2020 will number 39,000. This is the 1970 figure from Volume XV of Montana Agricultural Statistics (Montana Department of Agriculture 1974), and it was assumed to remain constant.

Horses

15. From 1970 to 2020, horses will increase in direct proportion to the DNRC projected population increase (Montana DNRC 1975).

Sheep

16. Sheep will increase 1.6241 times 1970 numbers of 2020, based on increased wool consumption (U.S. Department of Agriculture 1972).

FEED FOR LIVESTOCK

Varieties of Feed

Hay

17. Hay yields in 1970 were 1.15 tons per acre (T/A) from dry land and 2.08 T/A from irrigated land.

18. The amount of hay available for feed in 1970 was based on the 1968, 1969, and 1970 average, 3,859,660 tons.

19. It is assumed that 2020 hay yields from dry cropland which was dry cropland in 1970 will be 1.68 T/A and from irrigated land which was irrigated in 1970 will be 3.12 T/A.

20. Hay yields in 2020 for new irrigation will be 4.5 T/A. Yields from lands developed after 1970 are assumed higher than yields from land developed for irrigation before 1970 (assumption 19) for the following reasons:

    a. Old irrigated land ranges from high mountain meadows and intermountain native hay lands to the best-suited land for irrigation in the state; economics will dictate new development only of land capable of high production with long growing seasons.

    b. New land developed will utilize optimum fertilization, highest-yielding seed varieties, and best irrigation and management practices.

Range and Pasture

21. 1970 and 2020 range and pasture land yields are as follows:
    a. 1970 irrigated pasture--4 AUM/A (animal unit months per acre); range--4 A/AUM (acres per animal unit month);
    b. 2020 irrigated pasture--5 AUM/A; range--3 A/AUM.
22. New irrigated pasture in 2020 will yield 5.5 AUM/A.
23. Irrigated pasture in 1970 was estimated to total 571,149 acres, based on several sources.

Barley

24. Barley is fed only on feed lots.
25. Enough barley was produced in 1970 to satisfy the feed lot requirement. That the same will be true in 2020 is assumed here and is supported by OBERS projections.

Grazing after Harvest

26. Each acre of irrigated hay provides 1 AUM/A of grazing after haying.
27. One-half of all irrigated acres harvested for grain will provide ½ AUM/A of grazing after harvest.
28. One-fifth of all dry cropland harvested for grain will provide ¼ AUM/A of grazing after harvest.

Seasonal Feed Requirements

29. Livestock were fed four months in winter and eight months in summer in 1970.
30. Livestock will be fed five months in winter and seven months in summer in 2020. The extended winter season is to provide for maximum production from range and pasture.
31. Silage and hay are fed in winter, all other feeds in summer.

Agricultural Land Loss

32. Five percent of 1970 range, pasture, and hay lands will be lost to nonagricultural land uses by 2020.

EXPORT POLICIES

33. Grain and beef export policies current in 1970 were assumed to continue through 2020.

LIVESTOCK AND FEED IN MONTANA
IN 1970

TABLE 1

MONTANA LIVESTOCK FEED REQUIREMENTS IN 1970

	Number of Animals	AUM Factor	No. of Months	AUM Requirement
Beef Cows	1,589,000	1.06	12	20,212,080
Two-year-old heifers with calves	150,500	.8	12	1,444,800
One-year-old heifers	150,500	.7	12	1,264,200
Bulls	69,000	1.5	12	1,242,000
Calves	383,750[a]	.6	2	460,500
Steers	111,000	.7	9	699,300
Milk Cows	47,000	1.5	12	846,000
Horses	70,500	1.25	12	1,057,500
Sheep	857,000[b]	.2	12	2,056,800
Total AUMs required for 1970				29,283,180
Less AUMs for yearlings placed in feed lot during year (See table 3)				144,015
Grand Total				29,139,165[c]

SOURCE: Montana Department of Agriculture 1972 and U.S. Department of Commerce 1974.

[a] This is twenty-five percent of the total number of calves for 1970, 1,535,000. See assumption 4.

[b] The sum of ewes, one-year-old rams, and wethers.

[c] One-third of this requirement, 9,713,055 AUM, is winter feed. Two-thirds, 19,426,110 AUM, is summer feed. See assumption 29.

TABLE 2

AVAILABLE FEED IN MONTANA IN 1970

Feed Type	Amount Available: Quantity	Amount Available: Units	AUM/Unit	AUMs Available
Winter				
Hay	3,859,660	T (tons)	2.4	9,263,184
Silage[a]	643,200	T	.86[b]	553,152
Total				9,816,336
Less hay and silage fed in feed lots[c]				146,591
Total winter feed available				9,669,745
Summer				
Range[d]	65,652,162	A (acres)	.25	16,413,041
Irrigated pasture[e]	571,149	A	4	2,284,596
Beet tops[a]	922,000	T	.6661	614,144
Grazing after hay harvest[a]	1,194,400	A	1	1,194,400
Grazing after grain harvest[a]				
Irrigated	244,000	A	.5	122,000
Dry[f]	1,078,000	A	.25	269,500
Total summer feed available				20,899,681

[a] Montana Department of Agriculture 1974

[b] U.S. Department of the Interior

[c] From table 4

[d] U.S. Department of Agriculture undated

[e] See assumption 23

[f] This is 20 percent of all acres of dryland grain harvested in 1970. See assumption 28.

TABLE 3

CATTLE AND CALVES ON FEED BY QUARTER, 1970
(in thousands)

	Total Number of Cattle	Calves (450-900)		Steers (over 900 pounds)	
		Number	Percentage of total	Number	Percentage of total
January 1	115	87	95.5	28	24.3
April 1	87	68	78.2	19	21.8
July 1	73	51	69.9	22	30.1
October 1	74	46	62.2	28	37.8
Total	349	252	72.2[a]	97	27.8[a]
Average	87.25	63[b]	72.2[a]	24.25[b]	27.8[a]

SOURCE: Derived from Montana Department of Agriculture 1974.

[a] Throughout this publication, the approximate figures of seventy percent and thirty percent will be used.

[b] These numbers correspond approximately with those in the "Number of Animals" column of table 4. The slight disparity is due to the rounding of the numbers in the "Number" columns of this table before they were averaged; no rounding was done in the process of determining the corresponding numbers in table 4.

TABLE 4

180-DAY FEED LOT REQUIREMENTS IN 1970

Feed Type	Number of Animals	Ton/Head	AUM/Ton	AUMs Required
Calves[a]				
Barley	62,384	1.125	3.7	259,673
Silage	62,384	.67	.86	35,946
Hay	62,384	.450	2.4	67,375
Total				362,994
Steers[a]				
Barley	24,866	1.095	3.7	100,745
Silage	24,866	.935	.86	19,995
Hay	24,866	.390	2.4	23,275
Total				144,015
Hay and silage total				146,591
Grand total				507,009

SOURCE: U.S. Department of the Interior 1974

[a] Feed lot calves are defined as cattle weighing from 450 to 900 pounds; steers weigh over 900 pounds.

TABLE 5

FEED GRAIN AVAILABILITY IN 1970

	Tons Available	AUM/Ton	AUMs Available
Barley	1,563,168	3.7	5,783,722[a]
Oats	287,616	3.64	1,046,922
Feed Grain Total			6,830,644

SOURCE: Montana Department of Agriculture 1974 and U.S. Department of the Interior 1974.

[a] This exceeds the 1970 feed lot barley requirement of 360,418 AUM (see table 4).

TABLE 6

FEED AVAILABLE AND FEED REQUIRED IN MONTANA IN 1970 (in AUM)

	Feed Required	Feed Available	Shortage (-) or Surplus (+)
Winter	9,713,055	9,669,745	- 43,310
Summer	19,426,110	20,899,681	+ 1,473,571
Total Surplus			+ 1,430,261[a]

[a] That the 1970 net feed surplus as calculated using our assumptions was so small (4.9 percent of total available feed) was taken as an indication that the assumptions and methodology chosen were generally reliable.

LIVESTOCK AND FEED PROJECTIONS
FOR 2020

TABLE 7

MONTANA LIVESTOCK PROJECTIONS FOR 2020

	1970 Number[a]	2020 Number		
		1.82 Increase Factor	1.97 Increase Factor	2.43 Increase Factor
Cows	1,589,000	2,891,980	3,130,330	3,861,270
One- & Two-Year-Old Heifers	301,000	547,820	592,970	731,430
Bulls	69,000	125,580	135,930	167,670
Calves	1,448,000[b]	2,635,360	2,852,560	3,518,640
Steers	111,000	202,020	218,670	269,730
Milk Cows[c]	47,000	39,000	39,000	39,000
Horses[d]	70,500	92,567	92,567	92,567
Sheep[e]	857,000	1,391,768	1,391,768	1,391,768

[a] From Table 1

[b] To arrive at this figure, the 87,000 calf deaths in 1970 (Montana Department of Agriculture 1972) were subtracted from the total 1970 calf number of 1,535,000 (table 1, note a).

[c] See assumption 14.

[d] Increase factor 1.313. See assumption 15.

[e] Increase factor 1.624. See assumption 16.

TABLE 8

MONTANA LIVESTOCK FEED REQUIREMENT PROJECTIONS FOR 2020

	AUM Factor	No. of Months Fed	1.82 Increase Factor		1.97 Increase Factor		2.43 Increase Factor	
			No. of Animals	AUMs Required	No. of Animals[a]	AUMs Required	No. of Animals[a]	AUMs Required
Cows	1.2	12	2,891,980	41,644,512	3,130,330	45,076,752	3,861,270	55,602,288
Two-Year-Old Heifers[b]	1.0	12	273,910	3,286,920	296,485	3,557,820	365,715	4,388,580
One-Year-Old Heifers[b]	.7	12	273,910	2,300,844	296,485	2,490,474	365,715	3,072,006
Bulls	1.5	12	125,580	2,260,440	135,930	2,446,740	167,670	3,018,060
Calves	.6	2[c]	658,840[d]	790,608	713,140[d]	855,768	879,660[d]	1,055,592
Steers	.7	9[e]	202,202	1,272,726	218,670	1,377,621	269,730	1,699,299
Milk Cows	1.5	12	39,000	702,000	39,000	702,000	39,000	702,000
Horses	1.25	12	92,567	1,388,505	92,567	1,388,505	92,567	1,388,505
Sheep	.2	12	1,391,768	3,340,243	1,391,768	3,340,243	1,391,768	3,340,243
Total				56,986,708		61,235,923		74,266,573
Less 10% increased feeding efficiency[f]				5,698,680		6,123,592		7,426,657
Less feed for steers in feed lots (table 10)				480,657		520,271		641,756
Grand Total				50,807,461		54,592,060		66,198,160
Winter feed (5 mo.)[g]				21,169,775		22,746,692		27,582,567
Summer feed (7 mo.)[g]				29,637,686		31,845,368		38,615,593

[a] From table 7

[b] Two-year-old heifers require more feed than one-year-olds because of their increased size and because they have calves. See assumption 5.

[c] See assumption 4.

[d] Twenty-five percent of the total number given in table 7. See assumption 4.

[e] See assumption 7.

[f] See assumption 2.

[g] See assumption 30.

TABLE 9

AVAILABLE FEED IN MONTANA FOR 2020

Feed Type	Amount Available		AUM/Unit	AUMs Available
	Quantity	Units		
Winter				
Hay	2,075,758[a]	T(tons)	2.4	
Dry	3,540,202[a]	T	2.4	4,981,818
Irrigated	2,069,600[b]	T	.86	8,496,484
Silage	2,069,600[b]	T	.86	1,779,856
Total winter feed available				15,258,158
Summer				
Range	62,369,553[c]	A(acres)	.333	20,789,851
Irrigated pasture	542,592[c]	A	5	2,712,958
Beet tops[d]	2,207,000	T	.6661	1,470,083
Grazing after hay harvest	1,134,680[c]	A	1	1,134,680
Grazing after grain harvest				
Irrigated	31,800[e]	A	.5	15,900
Dry	1,024,100[e]	A	.25	256,025
Total summer feed available				26,379,497

[a] Calculated using 95 percent of 1970 acreage (see assumption 32) and projected 2020 hay yields (see assumption 19).

[b] U.S. Water Resources Council 1972, Volume 5

[c] Ninety-five percent of 1970 acreage. See assumption 32.

[d] From U.S. Water Resources Council 1972; assuming one ton of tops produced per ton of beets.

[e] One-fifth of 95 percent of 1970 acreage. See assumptions 27, 28 and 32.

TABLE 10

ANIMALS PRODUCED FOR BEEF IN MONTANA FOR 2020

	Number of Animals		
	1.82 Increase Factor	1.97 Increase Factor	2.43 Increase Factor
Calf production	2,635,360	2,852,560	3,518,640
Cull cows (80 percent)[a]	202,930	219,655	270,945
Steers	202,020	218,670	269,730
Less replacement heifers[a]	273,910	296,485	365,715
Total	2,766,400	2,994,400	3,693,600
10% of total sent to feed lots[b]	276,640	299,440	369,360
Calves (70%)[c]	193,648	209,608	258,552
Steers (30%)[c]	82,992	89,832	110,808

[a] See assumption 10.

[b] See assumption 12.

[c] From table 3.

TABLE 11

180-DAY FEED LOT REQUIREMENTS FOR 2020

Feed Type	Ton/Head	AUM/Ton[a]	1.82 Increase Factor		1.97 Increase Factor		2.43 Increase Factor	
			Number of Animals[b]	AUMs Required	Number of Animals[b]	AUMs Required	Number of Animals[b]	AUMs Required
Calves								
Barley	1.125	3.7	193,648	806,060	209,608	872,493	258,552	1,076,223
Silage	.675	.86		112,413		121,677		150,089
Hay	.450	2.4		209,140		226,377		279,236
Total				1,127,613		1,220,547		1,505,548
Steers								
Barley	1.095	3.7	82,992	336,242	89,832	363,954	110,808	448,939
Silage	.935	.86		66,734		72,234		89,101
Hay	.390	2.4		77,681		84,083		103,716
Total				480,657		520,271		641,756
Hay and Silage Total				465,968		504,371		622,142
Grand Total				1,608,270		1,740,818		2,147,304

[a] U.S. Department of the Interior 1974

[b] From table 10

TABLE 12

MONTANA FEED GRAIN PRODUCTION PROJECTIONS FOR 2020

Grain	Production		AUM/ Ton	Production in AUMs
	In Bushels	In Tons		
Barley	141,900,000	3,405,600	3.7	12,600,720
Oats	18,341,200	293,459	3.64	1,068,190
Feed grain total				13,668,910

SOURCE: U.S. Water Resources Council 1972 and U.S. Department of the Interior 1974.

NOTE: The feed grain production projected in table 12 is adequate to supply the feed lot requirement projections of table 11. For an increase factor of 1.82, 1,608,270 AUMs would be required for Montana feed lots, leaving 12,060,640 AUMs from the table 12 total. For an increase factor of 1.97, 1,740,818 AUMs would be required, leaving 11,928,092 AUMs. For an increase factor of 2.43, 2,147,304 AUMs would be required, leaving 11,521,606 AUMs, approximately eighty-five percent of the total, available for export.

TABLE 13

FEED AVAILABLE AND FEED REQUIRED IN MONTANA FOR 2020 (in AUMs)

Season	Feed Required[a] (1)	Feed Available[b] (2)	Hay and Silage Required for Feed Lots[c] (3)	Grazing Available after New Irrigated Hay Harvest[d] (4)	Net Shortage (5)	Converted to Acres of New Irrigated Hay (Winter)[e] or Pasture (Summer)[f] (6)
1.82 Increase Factor						
Winter	21,169,775	15,258,158	465,968	---	6,377,585	590,517 A
Summer	29,637,686	26,479,947	---	590,517	2,567,222	66,768 A
Total acreage required of new irrigated land						1,057,285 A
1.97 Increase Factor						
Winter	22,746,692	15,258,158	504,371	---	7,992,905	740,084 A
Summer	31,845,368	26,479,947	---	740,084	4,625,337	40,970 A
Total acreage required of new irrigated land						1,581,054 A
2.43 Increase Factor						
Winter	27,582,567	15,258,158	622,142	---	12,946,551	1,198,755 A
Summer	38,615,593	26,479,947	---	1,198,755	10,936,891	1,988,526 A
Total acreage required of new irrigated land						3,187,281 A

[a] From table 8

[b] From table 9

[c] From table 11

[d] Calculated from the acreage given in column 6 of the previous line. See assumption 26.

[e] Calculated by dividing the net shortage (column 5) by 2.4 AUM/T and 4.5 T/A (assumption 20).

[f] Calculated by dividing the net shortage (column 5) by 5.5 AUM/A (assumption 22).

THE POTENTIAL INCREASE IN IRRIGATED ACREAGE

TABLE 14

MONTANA'S POTENTIAL INCREASE IN IRRIGATED ACREAGE FOR 1980-2020, DEVELOPED FROM PROJECTIONS OF INCREASED RED MEAT PRODUCTION

	1980	1985	1990	2000	2020
			Low[a]		
Montana	211,457	317,186	422,914	634,371	1,057,285
Yellowstone Basin[d]	69,146	103,720	138,293	207,439	345,732
Missouri Basin[e]	120,319	180,479	240,638	360,957	601,595
Columbia Basin[f]	21,992	32,987	43,983	65,975	109,958
			Medium[b]		
Montana	316,211	474,316	632,422	948,632	1,581,054
Yellowstone Basin[d]	103,401	155,101	206,802	310,203	517,005
Missouri Basin[e]	179,924	269,886	359,848	539,771	899,620
Columbia Basin[f]	32,886	49,329	65,772	98,658	164,429
			High[c]		
Montana	637,456	956,184	1,274,912	1,912,369	3,187,281
Yellowstone Basin[d]	208,448	312,672	416,896	625,345	1,042,241
Missouri Basin[e]	362,713	544,069	725,425	1,088,138	1,813,563
Columbia Basin[f]	66,295	99,443	132,591	198,886	331,477

[a] Based on an increase factor of 1.82, developed from 1930-72 cattle production growth trends and population projections developed by the Montana Department of Natural Resources and Conservation.

[b] Based on an increase factor of 1.97, developed from 1948-72 cattle production growth trends and population projections developed by the Montana Department of Natural Resources and Conservation.

[c] Based on an increase factor of 2.43, developed from 1963-72 cattle production growth trends and population projections developed by the Montana Department of Natural Resources and Conservation.

[d] The Yellowstone Basin produced 32.7 percent of Montana's 1970 beef production.

[e] The Missouri Basin produced 56.9 percent of Montana's 1970 beef production.

[f] The Columbia Basin produced 10.4 percent of Montana's 1970 beef production.

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